

NASA Conference Publication 10196

HBCUs Research Conference Agenda and Abstracts

*Proceedings of a conference held at
Ohio Aerospace Institute
Cleveland, Ohio
April 9–10, 1997*



HBCUs Research Conference Agenda and Abstracts

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April 9-10, 1997

LeRC HBCUs CONFERENCE
HBCUs RESEARCH CONFERENCE
APRIL 9-10, 1997

TABLE OF CONTENTS

LETTER FROM THE DIRECTOR, LEWIS RESEARCH CENTER	1
LETTER FROM THE DEPUTY DIRECTOR FOR OPERATIONS	3
AGENDA	5
LIST OF POSTER PAPERS	7
ABSTRACTS	9
APPENDIX I: WHY COSTING IS IMPORTANT ON HBCU GRANTS	49
APPENDIX II: BIOGRAPHICAL DATA	57
APPENDIX III: LIST OF ATTENDEES	61

National Aeronautics and
Space Administration

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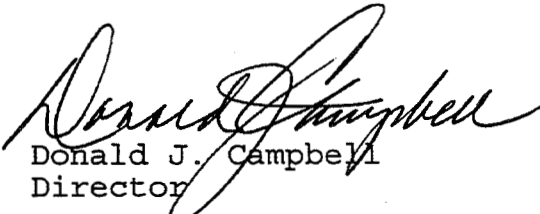
Reply to Attn of:

NASA Lewis Research Center's commitment to excellence continues to grow in terms of investment and support for Historically Black Colleges and Universities (HBCUs). Over the last 4 years, Lewis' total research and development grant awards to 16 HBCUs exceeded its performance goal by a substantial margin.

Lewis' HBCUs Research Program is designed to utilize the ability of HBCUs to conduct fundamental science and develop physical infrastructure related to NASA's disciplines. To reach our goals, we must build partnerships with other Government agencies, industry, and academia. Our research partnerships with the Nation's HBCUs are an integral part of our strategy.

The HBCUs Research Conference is a critical element in ensuring the success of Lewis research programs. In addition, it provides a forum for showcasing the research capabilities of the participating HBCUs.

It is with great pleasure that I welcome the participants and congratulate everyone associated with the Fourth NASA HBCUs Research Conference.


Donald J. Campbell
Director

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National Aeronautics and
Space Administration
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Reply to Attn of:

This Research Conference is the fourth one at which researchers and students from Historically Black Colleges and Universities (HBCUs) present progress reports on Lewis-sponsored research. Lewis management and researchers are proud of the results obtained to date and encouraged by the competence and contributions of the Principal Investigators (PIs) and student researchers.

I welcome all presenters and congratulate you for the comprehensive quality of topics covered by your research programs. Also, I congratulate and thank the Lewis Technical Monitors for their excellent support. The phrase "Lewis means teamwork" is directly applicable to the partnerships between Lewis and HBCUs.

A handwritten signature in cursive script that reads "Julian M. Earls".

Julian M. Earls
Deputy Director for Operations

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FOURTH HBCUs RESEARCH CONFERENCE

April 9-10, 1997

AGENDA

Presiding: Dr. Sunil Dutta
SDB Program Manager

Wednesday, April 9, 1997

8:30 - 9:00 a.m.	Introduction
Introduction and Welcome:	Dr. Julian M. Earls Deputy Director for Operations NASA Lewis Research Center
	Dr. Michael J. Salkind President Ohio Aerospace Institute
Welcome and Center Overview:	Mr. Donald J. Campbell Director NASA Lewis Research Center
9:00 - 10:20 a.m.	Oral Presentations Three (3) Concurrent/Parallel Sessions
10:20 - 10:40 a.m.	Break
10:40 - 12:00 Noon	Oral Presentations Four (4) Concurrent/Parallel Sessions
12:00 - 1:00 p.m.	Lunch (On Your Own)
1:00 - 2:20 p.m.	Oral Presentations Three (3) Concurrent/Parallel Sessions
2:20 - 2:40 p.m.	Break
2:40 - 4:40 p.m.	Poster Sessions

Thursday, April 10, 1997

8:00 - 12:00 Noon	Small Disadvantaged Business Forum
12:00 - 1:00 p.m.	Lunch (On Your Own)
1:00 - 3:00 p.m.	Individual Principal Investigator/Technical Monitor Meeting
3:00 - 4:00 p.m.	Remove Poster Sessions

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HBCU Research Conference
List of Poster Papers
April 9-10, 1997

P1	Alabama A&M University	"Heterodyne Interferometry for Crystal Growth Rate Diagnostics"
P2	Alabama A&M University	"Optical Sensors Based on Single Arm Thin Film Waveguide Interferometers"
P3	Central State University	"Development of a Searchable Database on General Aviation Propulsion"
P4	Central State University	"Stabilizing Effects of Trace Solutes on Evaporating Menisci in a Capillary Heat Transfer Device in Microgravity"
P5	Central State University	"Diamondlike Carbon Coatings for High Temperature Lubricant Applications"
P6	Clark Atlanta University	"Impact Resistance Modeling and Preliminary Fabrication of Hybrid Titanium Composite Laminates"
P7	Clark Atlanta University	"An Experimental Study for Mechanical Property Characterization of PMCS: Application to T650-35/AMB21"
P8	Clark Atlanta University	"Study of Atomic Monolayer Protective Surfaces for Photovoltaic Semiconductors"
P9	Clark Atlanta University	"X-ray Diffraction Studies of the Structure and Thermochemistry of Alkaline-Earth Oxide-Coated Thermionic Cathodes"
P10	Clark Atlanta University	"Investigation of Nonstandard Finite-Difference Schemes"
P11	Clark Atlanta University	"Design, Construction and Testing of Flows Through Combustor Inlets"
P12	Clark Atlanta University	"Turbulent Premixed Methane-Air Combustion"
P13	Florida A&M University	"Plasma-Enhanced Pulsed Laser Deposition of Wide Bandgap Nitrides for Space Power Applications"
P14	Hampton University	"Grating-Fiber Image Reproduction Technique for Bragg Reflection Filters"
P15	Hampton University	"Observations of Phase Mask Defects Using Grating-Fiber Imaging Techniques"
P16	Howard University	"Implementation of Reduced Order H_{∞} Robust Control Laws for Expendable Launch Vehicle"
P17	Howard University	"Modeling Cyclic Phase Change and Energy Storage in Solar Heat Receivers"
P18	Howard University	"Laser Spectroscopy and Chemical Kinetics Investigations of Transient Molecules of Relevance to Microgravity Combustion"

P19	Howard University	"Howard University Energy Expert Systems Institute Summer Program (EESI)"
P20	Howard University	"Fault Diagnosis of Power Systems Using Intelligent Systems"
P21	Howard University	"Decision Support System for Power Market Bidding Scheme"
P22	Howard University	"Design and Fault Analysis of Power System Architectures for Small Spacecrafts"
P23	Howard University	"Fault Analysis of Space Station DC Power Systems - Using Neural Network Adaptive Wavelets to Detect Faults"
P24	Howard University	"Artificial Neural Network Approach to Load Forecasting for a Hybrid Electric Vehicle"
P25	Howard University	"Application of Eigensensitivity Analysis to the Solution of Coupled Nonlinear Initial-Valued Ordinary Differential Equations"
P26	Howard University	"Intelligent Control Architecture for Unknown Multi-Input and Multi-Output (MIMO) Discrete-Time Nonlinear Drive Systems"
P27	Jackson State University	"Software Model for Rocket Engine Numerical Simulators"
P28	Johnson C. Smith University	"Conservation/Solution Element Methods for Second Order Linear Problems"
P29	North Carolina A&T State University	"An Investigation of SiC/SiC Woven Composite Under Monotonic and Cyclic Loading"
P30	North Carolina A&T State University	"Numerical Simulations of Wing-Body Junction Flows"
P31	North Carolina A&T State University	"Implementation of Brillouin Active Fiber Sensors in Smart Structures"
P32	Prairie View A&M University	"Low Cost, Wide Bandwidth, and High Gain Microstrip Antenna for Satellite and Personal Communications"
P33	Savannah State University	"ACTS for Distance Education in Developing Countries"
P34	Southern University and A&M College	"Inlet Distortion and Surge/Stall Instabilities in Axial Compression Systems"
P35	Tennessee State University	"Mathematical Modeling of Convective Melting of Granular Porous Media"
P36	Tennessee State University	"Effective Thermal Conductivity of Melting Granular Porous Media Using a Fractal Concept"
P37	Tennessee State University	"Visualization and Characterization of Convective Melting of Granular Porous Media"
P38	Tuskegee University	"On the Measurement of Low-Energy Sputtering Yield Using Rutherford Backscattering Spectrometry"
P39	Wilberforce University	"Research Institute for Technical Careers"

LeRC HBCUs CONFERENCE**Heterodyne Interferometry for Crystal Growth Rate Diagnostics**

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51-76

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291132 p.1

ABSTRACT

A non-contact optical heterodyne interferometry technique is used for the first time for in-situ monitoring of crystal growth rate from solutions. This technique is part of an overall optical diagnostic system characterizing the crystal growth phenomena. Optical heterodyne technique has the capability of measuring the growth rate at a resolution of 1 Å/sec. This technique can be modified for concentration field measurement for protein crystal growth. Protein crystal growth has been the most successful application of space processing in microgravity, providing proteins crystal of unprecedented quality and sizes for X-ray diffraction studies and drug design for AIDS, cancer, influenza and skin diseases. Diagnostics for protein crystal growth are required for various aspects of the growing process. (1) Characterizing the fluid immediately surrounding the growing crystal to understand the transport of solute to the crystal. (2) Observing the growth rate of the crystal surface itself with a time resolution of minutes. The modified optical heterodyne technique is demonstrated with the mixture of water and glycerin to simulate a slow growth of protein crystal, and with Triglycine sulfate (TGS) crystals. Concentration gradient field of dissolving triglycine sulfate (TGS) crystal has been studied by changing the ratio of water and glycerin mixture. This technique is applicable to solution crystal growth of optical crystals, proteins, and thin films grown by Molecular Beam Epitaxy (MBE).

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P2

LeRC HBCUs CONFERENCE

Optical Sensors Based on Single Arm Thin Film Waveguide Interferometers

p1

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ABSTRACT

Optical waveguide sensors are promising tools in reliable aeropropulsion control systems that have to sustain harsh environment and radio frequency interference. The sensors are compact and can be easily introduced in different points of an aeropropulsion system. Single arm optical interferometer utilizes the interference between different waveguide modes. The sensing effect results from the change in traveling conditions for different modes caused by the environment. Single arm interferometer is much less sensitive to mechanical vibrations in comparison with traditional double arm system with separated arms. This is especially important in aeropropulsion applications. The proposed novel single-arm interferometer employs modes of different orders. It is more sensitive to the change of temperature (2π phase shift per 2°C temperature change) with regard to their polarimetric analogs using orthogonal modes of the same order (TE and TM). The proposed approach also enables combining polarimetric and double-mode interferometer in one device that becomes more versatile. Our efforts toward the development of the sensor include material selection, development of fabrication technique, characterization, and testing. The waveguide interferometer is built using high temperature polyimide doped with various analytes such as metal substituted phthalocyanines. Preliminary study shows that 1,4,8,11,15,18,22,25-Octadecyloxy copper phthalocyanine changes significantly its optical absorption spectrum in a reversible manner after being exposed to various acid and alkali solutions. When several drops of acetic acid were added (3% acid concentration) to initially green solution of the phthalocyanine in ethanol, the color changed to brown. However, when several drops of this brown solution were added to acetone, the color changed back to green. The same behavior accompanied by the refractive index change is expected for the phthalocyanine being exposed to NH_3 , NO , NO_2 , CO , CO_2 , H_2S , and other gaseous products of combustion process in an aeropropulsion system. We discuss the design of the experimental gas chamber that will be used to characterize the response of the waveguide sensor to the above mentioned gases within the temperature range from 20°C up to 260°C . The dose of each particular gas will vary from zero up to 5 ppm. The chamber is now under construction at Alabama A&M University.

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Development of a Searchable Database on General Aviation Propulsion

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P1

ABSTRACT

Central State University, under NASA sponsorship, is developing a user-friendly, business-oriented, computer-based database of literature related to key technological developments that could impact the field of general aviation propulsion. The database draws on a broad range of information sources, and is intended to serve the needs of general aviation propulsion equipment and component manufacturers seeking information which will help them to improve their existing products or develop new products to serve the needs of this market. Information to guide the design of the database was developed through a telephone and mail survey of relevant attributes of companies in the general aviation propulsion industry. Examples of the types of information gathered include: areas of company technical information interest, favored information sources, research needs and objectives, available computer hardware and software resources, etc. As one result of the survey, Microsoft's® ACCESS© was selected as the application to house the database. The database design was developed by students and faculty at Central State. One group of students is currently actively gathering and entering literature citations into the database. A second group is continually testing and upgrading the operational aspects of the database. The database archives information from books, journal articles, conference proceedings, popular articles and other information sources. The archived data includes key fields related to authors (name, address, phone/fax, etc.), titles and subtitles of articles, information source (type, name, volume and issue numbers, pages, date of publication, etc.) key words, abstracts/summaries, author's affiliation, and publisher. Queries based on any of the fields, including Boolean combinations, are supported. The database will be available for distribution by mid-year 1997, and will be provided to industrial firms and schools, including selected high schools. Plans to allow periodic updating of the database via the Internet are being considered.

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LeRC HBCUs CONFERENCE

Stabilizing Effects of Trace Solutes on Evaporating Menisci in a Capillary Heat Transfer Device in Microgravity

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ABSTRACT

This research has focused on the hypothesis that a trace amount of a less-volatile solute to a volatile solvent may enhance the effectiveness of the heat transport from the near contact line region of an extended meniscus formed along a heated solid surface. Results, reported from earth-based testing with various cell configurations, have shown that the deleterious effects of thermocapillary flows near the meniscus contact line on interfacial stability and wettability could be lessened through addition of small amounts of a less-volatile solute. This enhancement is due to the competing effect of the concentration-induced surface shear forces with the temperature-induced surface shear forces near the contact line. Current 1-g research has focused mainly on identifying the conditions leading to the onset of instability. Drop tower experiments are underway to gain insight of the difference in dynamics of the unstable meniscus in low gravity versus normal gravity conditions. A capillary-pumped loop, designed for these experiments, is used to study the influence of critical variables such as the concentration of the binary mixtures; the size and configuration of the evaporator capillary tube; and the level of heat input, and its position relative to the meniscus. Observation of the meniscus instabilities during the free fall will help determine the critical values for both thermal and concentration Marangoni numbers (Ma_T and Ma_c). Such results are essential to determine the directions and define the requirements for space-based experiments. Ultimately, long-term low gravity glovebox experiments will be conducted in space to fully observe at a device level the impact of adding a less volatile solute in a solvent in a capillary heat transfer device in low gravity.

LeRC HBCUs CONFERENCE**Diamondlike Carbon Coatings for High Temperature Lubricant Applications**

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ABSTRACT

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P. 1

This research project is in its first phase for the development of an advanced solid lubricant for use at high temperatures by means of a laser - plasma scheme. Diamondlike carbon (DLC) films have several advantages in properties. These include low substrate deposition temperatures, nanometer scale smoothness and good mechanical and chemical properties. This system involves the use of an excimer laser to ablate a graphite target onto a silicon carbide or silicon nitride target. The high intensity of the laser can dissociates the carbon atoms to atomic and ionic species as well as electronically excited states. In addition to the laser excitation we have also incorporated a plasma discharge capability onto the graphite target by means of a capacitor/power supply system. The energy which is discharged into the vapor plume further excites the carbon species to even higher states. Thereby a large fraction of the deposited film form sp^3 bonds. At present we have designed and built a vacuum chamber capable of being pumped to a pressure of $\sim 4 \times 10^{-3}$ torr. The vacuum system has several ports for various accessories. These include ports for gas delivery, by means of mass flow controllers for upstream control, and ports for baratron pressure gauge and throttle valve for downstream control. The substrate holder assembly has been designed to incorporate an infrared heating element so that substrate temperatures can be varied from 25° to 400 °C. Prior work has indicated that DLC film hardness of ~ 38 GPa could be obtained by this combination as compared to hardness of ~ 24 GPa obtained by simple laser ablation.

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LeRC HBCUs CONFERENCE

Impact Resistance Modeling and Preliminary Fabrication of Hybrid Titanium Composite Laminates

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ABSTRACT

The primary motivation for this research emanates from fabricating impact test samples of hybrid titanium composite laminates and providing a basic understanding of the impact response of such laminated plates. Multilayer laminated plates (12 metal layers, 11 polymer layers) were fabricated by stacking alternate layers of metal sheet and polymer film. Samples of Dow Chemical Zetabon S262, a two-side ethylene copolymer coated steel tape, and samples of Dow Chemical DAF 622, a polyolefin based adhesive film, were processed into laminates. Complimentary impact experiments on these plates will be carried out at NASA Lewis Research Center. Analytical and numerical solutions are explored for the impact responses of two types of plates with equal areal weights. The loadings and the boundary conditions for these plates are the same and an impact load was applied at the center of each plate. Initially, a relatively simple hybrid laminated composite plate in which a polymer layer is sandwiched between two metallic layers and an isotropic plate were analyzed. Comparisons were made between the maximum equivalent stress of the isotropic plate and that of the hybrid plate. Additionally, comparisons of maximum deflections were made. Also, a 23 layer laminate and an isotropic plate with an equivalent areal weight of between 3 and 5 psf were examined. The effect of different shapes of pulse on the laminated composites was also examined. Three loading cases were considered, each being a function of time: (1) rectangular wave; (2) half sine wave; and (3) Dirac delta function. The effect of different pulse shapes on the impact response was evaluated. The response patterns from the results studied show significant differences in impact responses of hybrid composites and isotropic plates.

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An Experimental Study for Mechanical Property Characterization of PMCS: Application to T650-35/AMB21

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 041360
 MB50NLY
 291141 p1

ABSTRACT

The objective of this research is to identify the mechanisms of damage in tension-tension fatigue of unidirectional T650-35 carbon fiber/AMB-21 polyimide laminates under ambient and elevated temperatures. AMB-21 is a polymer developed by NASA LeRC as a non-carcinogenic environmentally friendly polyimide. An experimental study was conducted to investigate the mechanical behavior of the unidirectional T650-35/AMB-21 polymer composite system. Quasistatic tensile and fatigue properties were examined. Applied loads and resulting strains were recorded, and replica were taken during fatigue cycling to monitor damage progression and provide insight for future analytical modeling efforts. Accomplishments included successful fatigue testing with tabbed dog-bone shaped specimen in which failure occurred away from the tabs. The data obtained will help in assessing replacement of PMR-15 with AMB-21 as a matrix for high temperature applications. Fatigue experiments at room temperature have been conducted for several unidirectional dog bone samples at a level of maximum stress, $S_{max} = (0.70 - 0.90)\sigma_{ult}$, with $R_{\sigma} = 0.1 (\sigma_{min}/\sigma_{max})$. The S_{max} values were based on the average ultimate tensile strength, σ_{ult} , obtained from the static tensile test (234×10^3 psi). A cyclic load frequency of 10 Hz with a sinusoidal command wave form was employed. Young's Modulus was continuously monitored throughout the test by recording the strain and the associated load every 0.005 seconds during the cycling (i.e. 20 readings by cycle). A slight increase in stiffness at an early stage of the fatigue testing was observed and is most likely due to the straightening of the fibers during the loading process. However, no stiffness reduction was observed until failure of the specimens. All specimens failed suddenly in a fiber broom failure type associated with "popping" sounds caused by the fiber bundles fracturing. No ratcheting process is believed to have taken place, specially that no nonlinearity in the stress strain relation is observed.

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LeRC HBCUs CONFERENCE

Study of Atomic Monolayer Protective Surfaces for Photovoltaic Semiconductors

291142

pl.

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ABSTRACT

Semiconductors such as Si, GaAs and InP are well-known for their potentially wide use in high-speed electronics and long-wavelength optical circuits. They are also used, mainly in space technology, as solar cells (photovoltaics). Their efficiency is however reduced by radiation damage, nonradiative recombination of charge carriers and interactions with surroundings, such as oxidation. These processes can deplete the surfaces of the semiconductors or change the composition of the surfaces, to the detriment of their efficiency as photovoltaics. They are therefore treated with protective films. Superior protection of these surfaces may be possible by the use of adsorbed Sulfur and other elements, especially Sulfur together with alkali metals, or Selenium together with alkali metals. Results will be presented of studies of the surface structures of Silicon (100) 2X1 with adsorbed elemental Sulfur, Cesium, and Sodium (Na) atoms. The surface structures were studied under Ultra High Vacuum conditions (pressures in the range of 10^{-10} Torr) using the techniques of Auger Emission Spectroscopy, Work Function measurements, Low Energy Electron Diffraction, and Thermal Desorption Spectroscopy using a Quadrupole Mass Spectrometer. Evidence is shown that the reconstructed Si(100) 2X1 surface structure is modified by adsorbed elemental S to store the bulk terminated 1X1 structure of Si(100). In the correct proportions, adsorbed S together with adsorbed Cs or Na maintains the bulk terminated 1X1 surface structure of Si(100), and furthermore that relatively strong bonding occurs between the S and alkali metals atoms in the presence of the Si(100) surface. Recently a Scanning Tunneling Microscope has been added to the Ultra High Vacuum chamber, and further studies of the Si (100) 2X1 surface with adsorbed S and alkali metal atoms are planned using atomic scale imaging of the surface with the Scanning Tunneling Microscope.

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X-ray Diffraction Studies of the Structure and Thermochemistry of Alkaline-Earth Oxide-Coated Thermionic Cathodes

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ABSTRACT

This project is a cooperative agreement between NASA Lewis Research Center and Clark Atlanta University. The research is aimed at using X-ray diffraction to probe the structure and thermochemistry of alkaline-earth oxide films of the type used in oxide-coated thermionic cathodes and that are modified by the addition of chemicals either known or believed to have the potential to enhance the electron emission properties. Although the addition of scandium oxide and indium oxide has resulted in improvements in performance of the oxide cathode, the exact roles in emission enhancement played by these additives is not well understood. NASA LeRC's in-house effort is focused on characterizing the surface chemistry and thermionic emission properties of the oxide cathodes fabricated at Baldwin-Wallace College Experience at NASA LeRC shows that Auger surface analysis by itself does not reveal sufficient details on the coating chemistry to fully correlate with the enhanced electron emission properties. X-ray diffraction is an extremely useful tool to supplement *NASA's studies* and should provide the description of the structure and thermochemistry of the modified oxide coatings needed to better understand the relationship between coating chemistry and electron emission. The presentation will provide details on a preliminary investigation of the structure of an alkaline-earth oxide cathode using X-ray diffraction measurements at room temperature. Data analysis, carried out using Total Access Diffraction Database (TADD) and PC-Identify software, revealed the presence of the alkaline earth oxides, BaO, CaO, and SrO. In the future, cathode activation and testing will be carried out under ultra high vacuum (UHV) conditions in a custom-built UHV vac-ion pumped test chamber. This is necessary because of the susceptibility of the alkaline-earth-oxides to irreversible poisoning effects upon exposure to the atmosphere. X-ray data will be collected before and after cathode activation as a function of temperature and time to determine the changes occurring in the materials chemistry as a result of aging. Specular reflection analysis will be done using X-ray reflectivity measurements to gain information on surface smoothness and contamination, and coating thickness.

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LeRC HBCUs CONFERENCE

29/146

Investigation of Nonstandard Finite-Difference Schemes

p. 1.

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ABSTRACT

A large class of physical phenomena can be modeled by evolution and wave type partial differential equations (PDE). Few of these equations have known explicit exact solutions. Finite-difference techniques are an important method for constructing discrete representations of these equations for the purpose of numerical integration. Our project investigates the application of so-called nonstandard finite-difference schemes for several model nonlinear and linear PDE's and associated ODE's. The major goal is to build into the discrete representation of a given PDE as many of the properties as possible as exists for the original PDE. The purpose being the elimination of numerical instabilities, i.e., solutions to the discrete equations that do not correspond to any solution of the PDE. Results are presented on the application of these methods to the Burgers, Fisher, time-dependent and time-independent Schrödinger equations, and several other nonlinear PDE.

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LeRC HBCUs CONFERENCE**Design, Construction and Testing of Flows Through Combustor Inlets**

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ABSTRACT

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ABS ONLY
291147 p.1

An experimental design study of subsonic flow through inlets, nozzles and curved wall annular diffusers have been initiated. This study is being conducted to establish the most pertinent design parameters and hence performance characteristics for such devices, and the implications of their application in the design of engine components in the aerospace industry. The diffuser study is being tailored to reproduce performance characteristics which would enable designers of similar components to make good choice decisions without the need for additional experimentation. The experimental work involves the application of Computer Aided Design (CAD) software tool to the development of a plausible annular diffuser geometry and inlet tube combination. Five experimental run segments have been completed so far during FYs-95/96 involving flow visualization and quantitative flow estimates. Further investigations are continuing including the applications of Laser Light Sheet and 2D LDV system for qualitative analysis. The performance of diffusers based on pressure recovery coefficient has been demonstrated to be less superior to the kinetic energy dissipation approach, consequently, this effort would implement diffuser performance evaluation based on dissipated mechanical energy. The application of the discretized, full Navier Stokes and Continuity equations to the numerical study of the diffuser problem described above for the time-mean flow has now begun using NASA's NPARC CFD Code on SGI-IMPACT workstations. One of the objectives of this numerical work is to develop tutorial templates which can be used to bring new users of the code on board and to demonstrate its capability for general acceptability. We would attempt to predict the flow through curved wall diffusers first and then proceed to predict the influence of such Diffuser outflow on combustor tube inlets.

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Turbulent Premixed Methane-Air Combustion

291148
p1

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ABSTRACT

The study is enhancing the understanding of turbulent premixed combustion by establishing the effects of flow rate, fuel/air ratio and the presence of chlorinated hydrocarbons on the emissions and flow structure of a methane-air premixed combustor. The use of particle image velocimetry (PIV) to establish flow velocity distribution, streamlines and vorticity within a flame during combustion is being attempted, for the first time, in this study. Results on the effects of the process variables on emissions (CO , CO_2 , NO_x , total unburned hydrocarbons, etc.) will be presented and discussed. The flow structure of cold flow (no flame) and hot flow experiments will be presented. Interference of the combustion flame on the imaging of the seed particles continues to be a major challenge which is being addressed. Steps being taken to overcome this challenge will be discussed. The project continues to provide immense exposure, training and education to students in the areas of combustion fundamentals and diagnostics and the thermal sciences (thermodynamics, heat and mass transfer and fluid mechanics).

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LeRC HBCUs CONFERENCE**Plasma-Enhanced Pulsed Laser Deposition of Wide Bandgap Nitrides for Space Power Applications**

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p1

ABSTRACT

The need for a reliable, inexpensive technology for small-scale space power applications where photovoltaic or chemical battery approaches are not feasible has prompted renewed interest in high-efficiency radioisotope-based energy conversion devices. Although a number of devices have been developed using a variety of semiconductors, the single most limiting factor remains the overall lifetime of the radioisotope battery. Recent advances in the growth of very wide bandgap semiconductors may provide the means to solve the device lifetime problem, as the stronger bond strength suggests a greater degree of radiation resistance. In this presentation, the development of a new type of plasma-enhanced laser deposition system for the growth of very wide bandgap nitride-based semiconductors will be discussed, and initial deposition results will be presented.

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LeRC HBCUs CONFERENCE**Grating-Fiber Image Reproduction Technique for Bragg Reflection Filters**

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540-74
042997
291256 p1

ABSTRACT

A technique is introduced to view directly and to verify the spacing in a Bragg diffraction grating. This technique can be applied whether a Bragg fiber grating is being written in the transverse mode or with use of a phase mask, thus allowing the experimenter to preview the wavelength spacing in the Bragg filter and record it onto a photographic plate. Once the image has been recorded onto the film, the actual Bragg spacing can then be confirmed for consistency by analysis of the film image. Currently, the common method to determine the wavelength spacing is to first write the grating in the fiber and then wavelength scan the fiber for the resonance peak. This write-then-scan procedure works well for verifying that a grating has actually been written to the fiber and for establishing the resonance wavelength, but is inefficient and ineffective for previewing the Bragg resonance.

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LeRC HBCUs CONFERENCE**Observations of Phase Mask Defects Using Grating-Fiber Imaging Techniques**

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54-74
041367
ABSTRACT

ABSTRACT

291257 p1

Recently, Bragg gratings fabricated with a diffractive optical elements or phase masks have become of great interest to both researchers and the telecommunications industry. These phase masks are produced by photolithographic and other processes and have periodic grating structures etched into the surface of a silica based substrate. This paper reports an investigation of the defects observed in phase masks used to produce Bragg reflection gratings in D-shaped optical fibers and in custom made and telecommunication grade cylindrical optical fibers. Results are also compared with fibers written using the transverse holographic technique. Phase masks with pitches of 0.566 μm , 0.896 μm , and 1.059 μm were used. In addition, for comparison, transverse writing of a Bragg grating was performed using a frequency doubled argon-ion laser operating at the UV wavelength of 244nm and set to correspond to the 0.566 μm pitch phase mask. The results of these experiments along with a recently developed theoretical model are discussed.

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LeRC HBCUs CONFERENCE

Implementation of Reduced Order H_{∞} Robust Control Laws for Expendable Launch Vehicle

291259

P1

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ABSTRACT

As a part of NASA Grant NAG3-1445, we developed alternate control strategies for a class of expendable launch vehicles. Included in these alternatives to the classical proportional-integral-derivative (PID) control implemented in the autopilot control of several contemporary launch vehicles, were the application of modern optimal control theory (linear quadratic regulator-LQR/linear quadratic Gaussian-LQG) together with techniques to guarantee robustness such as the loop transfer recovery (LTR). Robustness is a particular issue in the case of the autopilot control of launch vehicles due to the large number of plant and control parameters which may be subjected to considerable variations from their nominal values under flight conditions. The flight profile of a typical launch vehicle is subjected to a large number of disturbances (due to aerodynamic loading, wind gusts, etc.). At the same time, the performance of the system must be maintained to some acceptable level; in other words a compromise between robustness and performance must be maintained in the design of any robust control system. Recently our group has obtained some success in the design of a reduced order H_{∞} robust controller which must function in the presence of various parametric uncertainties and disturbances in flight. The mathematical closed-loop models of the dynamics of a flexible launch vehicle including the effects of fuel slosh in the various stages are characterized by a large number of degrees of freedom. Robust control strategies using either LQG/LTR or H_{∞} techniques have shown some advantages in system performance as compared with the classical PID, in terms of reduction in transient times, maximum control effort (nozzle gimble angle), and reduction in high frequency oscillation overshoots. However, it is doubtful that such control strategies could be implemented with current state-of-the art on-board flight computers due to capacity limitations. It is therefore, necessary to design robust reduced order control strategies that can be implemented with current flight computational hardware but can also function in the original higher order system space. At present our group has successfully designed a robust reduced order H_{∞} controller based on only a fifth order system plant which shows superior performance as compared with the PID according to our 2-D simulation results. In the last six months we have successfully implemented the H_{∞} robust autopilot control logic into the 3-D EASY5-Dynamics and Control Systems Branch (EDAD 7710) launch vehicle simulation at NASA Lewis. The results indicate that a stable reduced order H_{∞} robust controller can be designed with a suitable compromise between robustness and performance.

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LeRC HBCUs CONFERENCE

Modeling Cyclic Phase Change and Energy Storage in Solar Heat Receivers

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ABSTRACT

29126/pl.

Numerical results pertaining to cyclic melting and freezing of the eutectic mixture LiF-CaF_2 in solar heat receivers are presented. Specifically, a physical and numerical model of the solar heat receiver component of NASA LeRC's Ground Test Demonstration (GTD) project is developed and results compared with available GTD experimental data. Multipli-conjugate effects such as the convective flow of a low-Prandtl-number fluid, coupled with thermal conduction in the phase change material (PCM), containment tube, and working fluid conduit, are accounted for in the model. A two-band thermal radiation model is also built-in (including aperture and receiver shell losses). The cyclic nature of the present melt/freeze problem is relevant to solar dynamic (SD) systems employing latent heat thermal energy storage (LHTES) to power solar Brayton engines in microgravity environments. The computer code HOTTube is used to generate results for comparisons with GTD experimental data in the balanced orbit mode for both the subcooled and two-phase regimes. Results are reported in the form of maximum and average canister surface temperatures, and receiver gas exit temperatures, all as a function of insolation level and TAC operating speed (via an equivalent gas mass flow rate). In addition, the instantaneous first law energy stored in the receiver is quantified as a precursor to predicting the so-called *thermal state-of-charge (SOC)* of the solar heat receiver. Knowledge of the SOC allows for better control strategies relating to power management schemes during such operations as peak power demand and emergency shutdowns with subsequent restarts.

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517-25
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29264 p.1

LeRC HBCUs CONFERENCE

Laser Spectroscopy and Chemical Kinetics Investigations of Transient Molecules of Relevance to Microgravity Combustion

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ABSTRACT

Microgravity phenomena are specially susceptible to even small perturbations and therefore nonintrusive diagnostic techniques are of paramount importance for successful understanding of reduced-gravity combustion phenomena. Our approach is to use the Laser-Induced Fluorescence (LIF) technique as a nonintrusive diagnostic tool for the study of combustion-associated free radicals and use the concomitant optogalvanic transitions to accomplish precise calibration of the laser wavelengths used for recording the excitation spectra of transient molecular species. In attempting to perform spectroscopic measurements on chemical intermediates, we have used conventional laser sources as well as new and novel platforms employing rare-earth doped solid-state lasers. For example, free radicals, such as hydroxyl (OH) and alkoxy (RO; R=CH₃, C₂H₅), are important chemical intermediates in many combustion processes. Ethoxy (C₂H₅O), for example, is an important alkoxy radical produced in combustion and oxidation processes involving hydrocarbons. We have performed an extensive laser excitation study of the revibrationally cold ethoxy radical. Seven molecular vibrational frequencies have been determined for the excited B ²A' state and eight frequencies for the ground state X ²A". In addition, vibrational and anharmonic constants for the C-O stretch mode have been determined via least-square fits for both electronic states. We have also studied the chemical kinetics of the methoxy (CH₃O) free radical in presence of nitrogen dioxide (NO₂) employing time-resolved LIF-spectroscopy. The concentration depletion of the methoxy free radical was monitored by variations in LIF-intensity and a Stern-Volmer plot provided the reaction rate constant $k = 5.918 \times 10^{-12} \text{ cm}^3/\text{molecule} \cdot \text{sec}$ at room temperature. Measurements were also conducted at higher temperatures (up to 200 °C), and the activation energy of the reaction between methoxy and nitrogen dioxide was determined to be $E_a = -4.876 \text{ kJ/mol}$. In connection with LIF spectroscopy experiments, precise wavelength calibration of the tunable lasers used is very important. The laser-assisted optogalvanic (LOG) effect provides a good solution for existing wavelength calibration inadequacies in the visible and near UV regions of the electromagnetic spectrum. We have conducted a detailed study of OG-transitions using a commercial Fe-Ne hollow cathode lamp, especially in the wavelength ranges 291-317 nm and 607-662 nm. More than 167 OG-spectral lines have been recorded in these two wavelength regimes, of which sixty have been successfully assigned to neon atomic transitions. It is envisioned that the laser spectroscopic and the associated optogalvanic investigations will prove of value for the elucidation of both normal gravity and microgravity combustion phenomena.

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Howard University Energy Expert Systems Institute Summer Program (EESI)

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ABSTRACT

Howard University, under the auspices of the Center for Energy Systems and Controls runs the Energy Expert Systems Institute (EESI) summer outreach program for high school/pre-college minority students. The main objectives are to introduce pre-college minority students to research in the power industry using modern state-of-the-art technology such as Expert Systems, Fuzzy Logic and Artificial Neural Networks, to involve minority students in space power management, systems and failure diagnosis, to generate interest in career options in electrical engineering; and to experience problem solving in a teamwork environment consisting of faculty, senior research associates and graduate students. For five weeks, the students are exposed not only to the exciting experience of college life, but also to the inspiring field of engineering, especially electrical engineering. The program consists of lectures and projects in the fundamentals of engineering, probability and statistics, cost benefit analysis, communication skills and computer skills. Field trips to special places of interest included NASA Goddard Space Center and The Smithsonian Institute were also part of the EESI program. The students are exposed to mini and major projects. Topics for the 1996 mini-projects were *Bus ride for data gathering for Load Forecasting for Electric Vehicle, Expert Systems for The Electric Bus and Faults in Typical Household Appliances*. Topics for the major projects included *Hybrid Electric Vehicle, Solar Dynamics and Cost Benefit Analysis of Transportation Systems*. On the final day, designated as "EESI Day", the students performed oral group presentations of their projects, and prizes were awarded to the best group. Since its inception in 1993, more than fifty participants from all over the world have benefited from the program. Our post-program survey conducted in 1996 indicates that nearly 85% of the participants are now in college studying engineering related disciplines. This program is greatly valued and sought after by the community at large, as evidenced by the large number of applicants whenever the program is advertised.

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LeRC HBCUs CONFERENCE

Fault Diagnosis of Power Systems Using Intelligent Systems

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ABSTRACT

The power system operator's need for a reliable power delivery system calls for a real-time or near-real-time AI-based fault diagnosis tool. Such a tool enables NASA ground controllers with the ability to re-establish a normal or near-normal degraded operating state of the EPS (a DC power system) for Space Station Alpha. This is achieved by isolating the faulted branches and loads of the system, thus allowing safe re-energization of those healthy branches and loads. A proposed solution involves using the Fault Diagnosis Intelligent System (FDIS) to perform near-real time fault diagnosis of Alpha's EPS by downloading power transient telemetry at fault-time from onboard data loggers. FDIS is an artificial intelligence tool comprised of forty parallel ANNs (using a clustering algorithm) augmented with a Wavelet transform feature extractor, and an expert system. This architecture not only enables this system to perform pattern recognition of the power transient signatures under noisy telemetry conditions, but also provides diagnosis of the fault type and its location, down to the orbital replaceable unit with very high accuracy levels. FDIS has been tested using a simulation of the LERC Testbed Space Station Freedom configuration including the topology from DDCU's to the electrical loads attached to the TPDU's. FDIS will work in conjunction with the Power Management Load Scheduler to determine what the state of the system was at the time of the fault condition. This information is used to activate the appropriate diagnostic section and to refine, if necessary, the solution obtained. It is concluded from the present studies that AI diagnostic abilities are improved with the implementation of the parallel ANN Clustering Algorithm/Wavelet transform pair, and expert system. The benefit of these studies provides NASA with the ability to quickly restore the operating status of a space station from a critical state to a safe degraded mode, thereby saving costs in experimentation rescheduling, fault diagnostics, and prevention of loss-of-life. Further, this research can be extended to other NASA projects such as Solar Dynamics.

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LeRC HBCUs CONFERENCE**Decision Support System for Power Market Bidding Scheme**

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ABSTRACT

In the new competitive power environment, buy/sell decision support systems are to find economic ways to serve critical loads with limited sources under different uncertainties, such as line loss or unit loss. The limited energy sources and their costs, network transfer capabilities significantly affect decision making. Current work in this area includes (1) time dependent system congestion and capability analysis, (2) time dependent optimal allocation of power sources under different load demands, and (3) cost based generation rescheduling scheme to eliminate system congestion. In this study, initial work on power system congestion analysis was conducted using power flow approach. Several system performance indices were developed to evaluate the degree of system congestion. These performance indices include both a circuit overload index and a system voltage problem index. Sensitivity analysis approach was used to identify dominant factors leading to system congestion. Based on this study, the costs of different service schemes will be determined. The information will help market players to make their bidding decisions. The proposed approach will be tested on both terrestrial and aerospace power system. Simulation studies will identify system congestion and transfer capability for different generation schedules and load levels at different periods of time.

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SCHEDULES

BIDDING

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LeRC HBCUs CONFERENCE**Design and Fault Analysis of Power System Architectures for Small Spacecrafts**

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ABSTRACT

Industries and university partners from all over the country are teaming to participate in the New Millenium Program (NMP) in order to develop and demonstrate the breakthrough technologies for low cost space science missions for the 21-century. The aim of the NMP is to develop and implement new technologies such as innovative architectures and devices that will enhance capabilities and reduce mission costs. This will lead to reductions in spacecraft size and mass, launch vehicle size and overall system monitoring. The diminutive spacecraft will possess high levels of autonomy allowing extra navigational precision. In this study five candidate power system architectures for small spacecrafts were compared based on such attributes like mass, energy consumed, reliability and cost. Our preliminary calculations identified the most optimal architectures as architecture 1 and architecture 5. Futhermore software programs have been developed for the evaluation of the above attributes in Visual Basic which gives results for mass, reliability, energy consumed and cost the provided the appropriate inputs are provided. The five architectures IV charateristics are being simulated on a software package called SPICE. This will yield system performance based on various fault studies conducted on the EPS. Our goal is to identify optimum architectures as a function of aforementioned attributes, as well as the ability to correctly locate and isolate a system fault using AI.

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Fault Analysis of Space Station DC Power Systems - Using Neural Network Adaptive Wavelets to Detect Faults

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522-63
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p1

ABSTRACT

More recently, Artificial Neural Network (ANN) techniques have been used to solve fault diagnosis problems in power system. The use of neural network based scheme for fault detection and classification is only in its first stage. In these works, a pre-processing of fault signals by Fast Fourier Transform (FFT) is used. It is a two stage process. The first stage is feature extraction, the second stage is the training of ANN. The disadvantages of this scheme are (1) The procedure may be time consuming, and (2) FFT technique can be applied with success to steady state phenomena but short-time events require different mathematical tools to aid the analysis. Wavelet transform (WT) shows promise for both signal (or image) representation and classification. It has been successfully used in many areas such as optical computation, seismics, acoustics, and mechanical vibrations. The representation and classification both can be viewed as feature extraction problems in which the goal is to find a set of daughter wavelets that either best represent the signal or best separate various signal classes in the resulting feature space. For these applications, wavelet analysis overcomes the limitations of Fourier method by employing analysis functions that are local both in time and frequency and allows the convenient representation and classification of duration signals. Recently, several papers have been presented for power system transient signal analysis. These works focused on the representation of transient signal. An optimization procedure is needed for the calculations of wavelet transform coefficients (a_j , b_j). This procedure may be time consuming. On the other hand, the best set of wavelets for representation will not necessarily be the same as the best set for classification. As a new tool, wavelets have not been applied to the classification problem of aerospace power system fault diagnosis and controls. In this paper, we discuss how wavelet transform coefficients can be adaptively computed in the training stage of ANN. Each daughter wavelet is represented by a weight front input layer to first hidden layer. The neurons of the first hidden layer differ from the neuron of other hidden layers. The inspiration functions of neurons in first hidden layer are linear functions, so that the first hidden layer introduced for wavelet transform can be compressed to the second layer. The wavelet transform coefficients are automatically computed in the training stage of neural network. This neural network adaptive wavelet scheme is applied to the fault diagnosis of space station power system. The proposed scheme is tested on a space station power system, simulation results show that the proposed method is very efficient for the identification of the distribution system faults at different locations. The misclassification band for most faults is about 10% -15% line length from the sending end bus.

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Artificial Neural Network Approach to Load Forecasting for a Hybrid Electric Vehicle

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ABSTRACT

The control system of the Hybrid Electric Vehicle (HEV) must determine the optimal power management to meet a given load demand for different weather and road conditions for a specific route. The optimal management of available sources of energy (batteries, capacitors etc.) can be achieved by forecasting the load demand as accurate as possible. Consequently, the importance of load forecasting arises. The primary motivation for this Forecaster emanates from providing a decision support system to the electric bus operators in the municipal and urban localities which will guide the operators to maintain an optimal compromise among the noise level, pollution level, fuel usage etc. It is expected that such a decision support system would also be useful to other transport modes like metro rail services and even electrical two-wheelers. Several techniques were used for load forecasting which can be divided into two groups, the first group contains traditional algorithmic techniques which includes regression and time series methods and the second group includes advanced techniques using Artificial Neural Network (ANN). The benefit of using ANN over algorithmic approaches lies in its capability to perform non-linear modeling and adaptation. Furthermore it does not require the assumption of any function that relates the input variables to the output variables. This becomes useful for predicting load trajectory for HEV. The paper discusses the design and implementation methodology of the ANN based load forecasting module. It exploits retrained network that adapts changes in road, weather and other practical condition. In building our forecaster, some statistical analysis have been found to be very helpful in determining which variables have significant influence on the system load such as historical loads. Weather temperature, Wind effects, resistive forces and Time of the day, other variables, can be considered as an input such as humidity as an example but their effect on the load is not significant. The testing process covers different times of the day at different loading conditions the results were promising especially with accurate collected data. Thirty Training patterns were used to train our proposed ANN based load forecaster for HEV. In order to avoid the number of training process to update the network weights and thresholds for changes in the Input variables, a large number of training data is used in the training process so that only few patterns may be needed for updating the network weights and thresholds when it is necessary. In order to control the amount of the database needed for the training process some control variables are not included as input variables to the network such as lighting and heating or air conditioning loads since they are approximately constant.

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Application of Eigensensitivity Analysis to the Solution of Coupled Nonlinear Initial-Valued Ordinary Differential Equations

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ABSTRACT

The object of this research is to develop new methodology to solve a system of nonlinear coupled initial-valued ordinary differential equations obtained through spatial discretization of the equations governing nonlinear structural vibrations. A feasibility study, begun as part of a grant on ELV modeling and analysis, suggested that sensitivity analysis methods, particularly eigensensitivity analysis, are extremely promising for polynomial type nonlinearities. Thus, attention has primarily been focused on the multiple degree-of-freedom Duffing problem of the form $\mathbf{M} d^2\mathbf{X}/dt^2 + \mathbf{K} \mathbf{X} + \varepsilon \mathbf{N}(\mathbf{X}) \mathbf{X} = \mathbf{0}$, where \mathbf{M} and \mathbf{K} are known matrices, and \mathbf{N} is a matrix whose elements are known quadratic functions of the components of the response vector \mathbf{X} . The method consists in first transforming the Duffing equations into an algebraic nonlinear eigenvalue equation with multiple eigenvalues. If the response of the system is known to be periodic, then an expansion of \mathbf{X} in a Fourier Series with an unknown frequency (eigenvalue) in conjunction with the Galerkin method leads to the desired nonlinear eigenvalue equation. If the response is not periodic, perturbation theory is employed in order to suggest a basis suitable for transforming the differential equations into a nonlinear eigenvalue equation. The matrices in the eigenvalue equation are decomposed into diagonal and off-diagonal components, and eigensensitivity analysis is used to determine a solution for the eigenvalues and eigenvectors in a series about the off-diagonal matrix elements. Ongoing research issues center around the procedure for transforming the differential equations into a discrete eigenvalue problem. Current indications are that the eigensensitivity method almost always yields excellent approximate solutions to the discrete eigenvalue problem. Our remaining task is to develop a discretization procedure that is equally accurate at predicting the response of the equations of motion.

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LeRC HBCUs CONFERENCE**Intelligent Control Architecture for Unknown Multi-Input and Multi-Output (MIMO)
Discrete-Time Nonlinear Drive Systems**

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525-63
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ABS 0427
291275
p1

ABSTRACT

This work presents a learning Architecture for identification and control of non-linear induction motor dynamics with unknown parameters. The control architecture includes a neural network for identification, and another for control. The neural identifier estimates the unknown nonlinear parameters of the induction motor in real time, while the neural controller adaptively adjusts the rotor speed of the motor to follow a predetermined reference track. The role of the neural identifier is to learn the mapping of the closed-loop system dynamics under different operating conditions. The control and identification parameters are adjusted simultaneously in real-time using a dynamic learning algorithm. Both identification and control are carried out at pre-specified (and possibly different) time intervals, as the system is in operation. The proposed architecture adapts and generalizes its learning to a wide variety of loads and in addition provides the necessary abstraction when measurements are contaminated with noise. Extensive simulations reveal that neural designs are effective means of system identification and control for time-varying nonlinear systems, in the presence of uncertainty. The difficulties addressed by this work include incomplete system knowledge, nonlinearity, noise, and delays.

LeRC HBCUs CONFERENCE**Software Model for Rocket Engine Numerical Simulators**

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ABSTRACT

Object-oriented analysis and design technique is used to develop a software model for the rocket engine numerical simulator (RENS) executive. Object-oriented decomposition results in smaller system through the reuse of a common mechanism. Object-oriented design is more resilient to change and can be developed over time. An object-oriented project for the RENS will be iterative and incremental. The procedure for (RENS) will involve successive refinement of an objected-oriented architecture over each release to the next iteration of analysis and design. It is incremental in the sense that each pass of (RENS) an analysis and design cycle will lead to gradual refinement. Booch's notation is used for developing the model. The software model is constructed using Rumbaugh's technique. An object model of the (RENS) is constructed. In this model classes, attributes of the objects, and association between the different class is established. Rational Rose Software is used to draw the graph.

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291276 pl.

LeRC HBCUs CONFERENCE**Conservation/Solution Element Methods for Second Order Linear Problems**

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ABSTRACT

29/277/1850127

The Conservation/Solution Element Method applied to a second order linear problem presents unusual challenges compared to standard methods. A large number of unknowns are introduced on each cell, consequently we must find more equations to obtain a fully determined system. Even for simple rectangular geometries, we lose symmetry and positivity of the resulting matrix. Using third order Taylor expansion for the scalar unknowns, reducing the second order linear problem to first order systems, introducing dipole moment equations, and cell interface continuity requirements lead to a severely ill - conditioned system. We investigate alternative methods of balancing the resulting linear system without imposing too many unnatural or redundant equations or continuity requirements. As much as possible, we limit ourselves to the most fundamental concept of the method - conservation on cells and flux balance across interfaces. To do this, we develop a set of equations by choosing conservation elements that coincide with solution elements. More equations are developed using conservation elements that do not coincide with solution elements, but are staggered.

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LeRC HBCUs CONFERENCE**An Investigation of SiC/SiC Woven Composite Under Monotonic and Cyclic Loading**

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528-24
041 381
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ABSTRACT

The desirable properties in ceramic matrix composites (CMCs), such as high temperature strength, corrosion resistance, high toughness, low density, or good creep resistance have led to increased use of CMCs in high-speed engine structural components and structures that operate in extreme temperature and hostile aero-thermo-chemical environments. Ceramic matrix composites have been chosen for turbine material in the design of 21st-century civil propulsion systems to achieve high fuel economy, improved reliability, extended life, and reduced cost. Most commercial CMCs are manufactured using a chemical vapor infiltration (CVI) process. However, a lower cost fabrication known as melt-infiltration process is also providing CMCs marked for use in hot sections of high-speed civil transports. The scope of this paper is to report on the material and mechanical characterization of the CMCs subjected to this process and to predict the behavior through an analytical model. An investigation of the SiC/SiC 8-harness woven composite is ongoing and its tensile strength and fatigue behavior is being characterized for room and elevated temperatures. The investigation is being conducted at below and above the matrix cracking stress once these parameters are identified. Fractography and light microscopy results are being studied to characterize the failure modes resulting from pure uniaxial loading. A numerical model is also being developed to predict the laminate properties by using the constituent material properties and tow undulation.

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Numerical Simulations of Wing-Body Junction Flows

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NBS ONLY
291279p1

ABSTRACT

The goal of the research project is to contribute to the optimized design of fan bypass systems in advanced turbofan engines such as the *Advanced Ducted Propulsors* (ADP). The immediate objective is to perform numerical simulation of duct-strut interactions to elucidate the loss mechanisms associated with this configuration that is characteristic of ADP. These numerical simulations would complement an experimental study being undertaken at Purdue University. As the first step in the process, a numerical study of wing-body junction flow is being undertaken as it shares a number of characteristics with the duct-strut interaction flow. The experimental data from Kubendran et al. (AIAA Journal, Vol. 24, No. 9, pp. 1447-1452, Sep. 1986) are being used for comparison. The code NPARC is used for numerical simulations. Grids for the simulation have been generated using a multisurface algorithm. Results obtained so far are presented and discussed.

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LeRC HBCUs CONFERENCE**Implementation of Brillouin Active Fiber Sensors in Smart Structures**

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530-35
041383
ABSTRACT
29/280
pl

ABSTRACT

We propose to address the critical technology issues related to the implementation of Brillouin active fiber sensors in smart structures. Extensive exploratory work has been completed in assessing the adequacy of employing simultaneous stimulated Brillouin Scattering (sBs) and the resonant Guided Acoustic Wave Brillouin Scattering (GAWBS) mechanisms in singlemode optical fibers for sensing fiber parameter and ambient variations. Initial success has led to the initiation of studies in sBs suppression and enhancement in sensing for temperature and strain based on sBs shift and threshold sensitivity to these measurands. Work is also ongoing in assessing GAWBS as an auxiliary backup sensor, and as a fiber self checking tool for health. Fiber sensor optimization will lead to special fiber design for specific sensing applications. Issues of fiber bonding to and embedding in structures in normal and harsh environments must be addressed. Data retrieval from multiple and multipoint sensor arrays is an essential step in practical sensor implementation. Fusion of fiber sensors to actuators, such as shape memory alloy strands, and controls via artificial neural networks is also being examined.

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LeRC HBCUs CONFERENCE**Low Cost, Wide Bandwidth, and High Gain Microstrip Antenna for Satellite and Personal Communications**

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and

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531-32
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 29/28/ P1

ABSTRACT

It has been demonstrated experimentally that a coaxially-fed rectangular patch antenna with U-shaped slot has an impedance bandwidth of around 30% and a gain 2-3 dB higher than the regular patch without the slot. These characteristics were achieved without the use of parasitic patches. It is proposed that a microstrip antenna array be developed using the U-shaped slot patch as the antenna element. It is anticipated that the new design is superior to current designs using stacked parasitic patches because it is lighter in weight and thinner in profile. In the original proposal, both theoretical and experimental investigation of the antenna were proposed. This renewal proposal is for the continuation of the theoretical investigation of the antenna only due to the budget constraints. A computer code based on finite-element time-domain (FDTD) method for designing the antenna is being developed at Prairie View A&M University. The computer program is written in C. It targets the single U-slot patch antenna and has about 2000 lines. After its validation, it will be refined with more meshes and another program for stacked antenna will also be developed based on the current program. When completed, these simulation programs will be used to fully investigate the characteristics of the U-slot microstrip antenna, such as effect of substrate material, patch width among others to the antenna performance at central different frequencies.

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LeRC HBCUs CONFERENCE

ACTS for Distance Education in Developing Countries

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and

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291282 pl

ABSTRACT

The primary objective of this project is to use advanced communications technology to positively influence the energy infrastructures of developing countries. Photovoltaic (PV) systems can help meet the need for electrical energy in rural communities. However, a major challenge is the lack of indigenous personnel with a working knowledge of PV systems and the associated skills required to maintain proper system operation. Distance education can provide information on operation and maintenance of photovoltaic systems, but time must be allowed for the learning curve before proficiency is achieved. Implementation of supervisory control and data acquisition (SCADA) networks for monitoring and controlling PV systems can accelerate and enhance this process. The Advanced Communications Technology Satellite (ACTS) provides the opportunity to develop this technology using ultra small aperture terminal (USAT) ground stations and Ka band transmissions. With antenna diameters of 35 cm, these USATs are very portable making them ideal for remote locations. This presentation will describe the experimental design of a technology verification experiment (TVE) which will take place in Spring of 1997. Two USAT ground stations spaced an optimum distance apart will be located in the fixed ACTS Tampa/Orlando beam. These will comprise the remote terminal units of the SCADA network. The hub will be the Link Evaluation Terminal (LET) in Cleveland. USAT ground stations will be characterized with respect to signal attenuation as it relates to link availability. Because rain is the greatest contributor to Ka band signal attenuation, Florida, with its subtropical rainfall, provides an ideal climate for these tests. Four issues will be addressed in the experimental design; diversity as a method of rain fade compensation, signal depolarization during rain events, bit-error rate using code division multiple access (CDMA) modulation, and transponder isolation of the beam-forming-network signal.

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LeRC HBCUs CONFERENCE**Inlet Distortion and Surge/Stall Instabilities in Axial Compression Systems**

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533-34
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ABSTRACT

In this paper, we develop a set of nonlinear partial differential equations, using fluid mechanics, to predict axial compression system instabilities: rotating stall and surge, in the presence of inlet distortion. With mode truncation, it is possible to reduce these equations to ordinary differential equations. Bifurcation analysis is then performed to study the types and regions of instabilities due to parameter changes.

LeRC HBCUs CONFERENCE

Mathematical Modeling of Convective Melting of Granular Porous Media

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534-25
 041387
 ABS ONLY
 29/285

ABSTRACT

Study of melting of dispersed or packed solid particles in a fluid under gravity and microgravity conditions provides benchmark information for many engineering applications such as material processing, environmental assessment and protection and space fire protection. During such processes, packed or dispersed solid particles are interacting with fluid flow at above-melting temperatures. A mathematical model is presented for convective melting of a granular porous medium (packed bed) saturated with liquid. Initially, the packed bed consists of solid grains and it is saturated with still liquid. The downstream interface of the packed bed with the liquid is fixed. As the liquid flows through the bed, the solid grains within the bed are melting. As a result, the volume of the packed bed reduces and as solid particles are moving, repacking of the bed occurs. The mathematical model includes mass, energy, and momentum balance equations for the liquid and solid phases. For the liquid phase, we consider the conservation equations for the mass, energy, momentum. The effect of inter-particle conduction is considered through the effect of the Biot number on the effective heat transfer coefficient. The motion of the solid particles is described by a velocity distribution within the packed bed with respect to the upstream interface between liquid and the packed bed. The semi-empirical velocity distribution is deduced from experimental data. The repacking of the bed is considered through a compaction equation for the number of grains per unit volume. The decrease in the average characteristic dimension of a solid particle is estimated based on geometrical considerations. To validate our numerical model important quantitative parameters such as the total melting time for the entire packed bed and the melting front velocity are compared against experimental results.

LeRC HBCUs CONFERENCE**Effective Thermal Conductivity of Melting Granular Porous Media Using a Fractal Concept**

Adrian S. Sabau, Yong X. Tao, Ganewei Liu, and G. Vidhuvalavan

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Nashville, Tennessee 37209-1561

535-25
041388
ABS ONLY
29/286**ABSTRACT**

When a porous medium, saturated with a liquid flow, undergoes a deforming or phase change process for the solid phase, the prediction of heat transfer and flow characteristics becomes more complicated because of variable effective properties. One of such properties is the effective thermal conductivity, which is not only a function of local porosity but also affected by the local surface geometry of the particle. It has been observed that under dynamic flow conditions, non-thermodynamic equilibrium exists near flow-particle interface, the local geometry exhibits a random fashion that might be described by fractal dimensions. In this study, analytical correlations are derived for the effective thermal conductivity of Granular Porous Media (GPM). The deforming GPM is composed by semicircular ice particles. It is intended, however, that the analytical procedure presented can be apply to any type of deforming GPM. Conduction heat transfer effects in the GPM are considered with a Representative Unit Cell (RUC), which is used to describe the geometrical properties of the porous medium. Pictures of the cross-section of melting GPM under different degrees of thermal non-equilibrium are processed to provide digital data for measuring local fractal dimensions. Local fractal dimensions are next used to determine an equivalent Representative Unit Cell (RUC) for the particular case of the granular media considered. Finally, an analysis of heat conduction at the RUC level provides an analytical expression for the effective heat transfer coefficient. Results are presented for upper bound and lower bound values of effective thermal conductivity as a function of thermal conductivity ratio of solid to fluid. It is shown that the model prediction from this study agrees better with experimental results compared with existing models.

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LeRC HBCUs CONFERENCE

Visualization and Characterization of Convective Melting of Granular Porous Media

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536-25
 041389
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 291288 p1

ABSTRACT

Various models have been proposed to predict the key parameters in macroscopic transport phenomena occurring in phase change porous media. Due to the complex interaction among the physical quantities involved in these phenomena, it is necessary to conduct experimental investigation to validate such numerical and analytical predictions. In this work experiments are conducted to investigate the melting characteristics of a packed bed made of ice particles with an initially uniform, semi-cylindrical shape. The bed is initially saturated with still liquid. The downstream interface of the packed bed with the liquid is fixed. As the liquid flows through the bed, each solid grain experiences a microscopic (particle dimension level) melting process under a temperature and flow distribution. By employing an open test section, the temperature profile of the melt can be determined by the use of an infrared camera. Two configurations of packed beds are considered in this study: (a) forced-packed bed and (b) free-packed bed. The solid grains are kept packed during melting only for the case of forced-packed bed. For the case of free-packed bed, the solid grains are set free during the melting process. Therefore, as grains melt, ice particles are dispersed. Experiments are conducted for a given range of parameters, which include upstream melt temperature and velocity. Important quantitative parameters such as the total melting time for the entire packed bed and the melting front velocity are determined. The temporal geometric characteristics of the melting packed bed are identified. It is found that there exists a transition Reynolds number (defined based on the hydraulic diameter of the test section) beyond which the melting of the packed bed is one-dimensional. It is expected that such transition should not exist under microgravity testing condition, although the anisotropy of particles may still lead to rotational motion of particles even with the absence of gravity.

LeRC HBCUs CONFERENCE**On the Measurement of Low-Energy Sputtering Yield Using Rutherford Backscattering Spectrometry**

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537-73
041390
RASONLY
29/292 p/

ABSTRACT

An experimental study is described to measure low-energy (less than 500 eV) sputtering yield of molybdenum with xenon ions using Rutherford Backscattering Spectrometry (RBS). This work was initiated to quantify the erosion observed in long-duration tests of xenon ion thrusters. An ion gun was used to generate the ion beam. The ion current density at the target surface was approximately $30 \mu\text{A}/\text{cm}^2$. The sputtered material was collected on a thin aluminum strip which was mounted on a semi-circular collector plate. A hole in the center of the collector plate and the foil allowed the passage of the ion beam. The target was bombarded with 500 eV and 200 eV xenon ions at normal incidence to deposit enough sputtered material on the aluminum foil. The differential sputtering yield was measured using the RBS method with 1 MeV helium ions. The backscattered helium ions were detected with a silicon surface-barrier detector at a scattering angle of 155° . The helium ion beam was approximately 2 mm in diameter. The points along the aluminum strip where the measurements were made were 2 mm apart. The differential yields were fitted with a cosine fitting function and integrated with respect to the solid angle to provide the total sputtering yield. The sputtering yields obtained in the RBS method are in reasonable agreement with those measured by other researchers using different techniques.

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LeRC HBCU CONFERENCE

Research Institute for Technical Careers

Herbert C. Smitherman
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ABSONLY
291293 pl

ABSTRACT

NASA funding of RITC is enabling Wilberforce University to provide significantly improved learning opportunities to engineering and science students attending our school. This is being accomplished in a number of ways including offering an intensive pre-freshman summer experience, improving laboratory and computer facilities, encouraging involvement in research projects and providing exposure to NASA Lewis' scientists, engineers and other resources. Those students who take advantage of WISE (Wilberforce Intensive Summer Experience) learn to improve important skills which enable them to work at higher levels in mathematics, science and engineering courses throughout their college careers. Laboratory and computer facilities have been improved under this program through the acquisition of important laboratory equipment, the establishment of new electronic and design laboratories and the purchase of computers and software. These improvements, combined with significant changes in the curriculum, have enabled Wilberforce to now offer degree programs in electrical engineering and computer science and improved courses in other areas of science and mathematics. RITC has also provided the opportunity for Wilberforce scientists and engineers to participate in meaningful research both at Wilberforce and at NASA Lewis Research Center and to involve our students in this work. The program has produced collaborations between NASA scientists and Wilberforce faculty involving both teaching and research. Through the program, faculty have collaborated on NASA research and NASA scientists have served as visiting professors at Wilberforce. The resulting training in research techniques and the exposure to an advanced research environment is very helpful to Wilberforce students as they transition to work and/or graduate school. A final benefit of NASA sponsorship of RITC is that it is helping Wilberforce to build the necessary infrastructure to attract additional funding for expanding our research and educational activities.

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LeRC HBCU CONFERENCE

Parallelization of Rocket Engine System Software (Press)

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ABSTRACT

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This project is part of a collaborative effort with Southern University at Baton Rouge (SUBR), University of West Florida (UWF), and Jackson State University (JSU). The second-year funding continues to support the principal investigator and two graduate student research assistants. The stipend support for graduate students is important in the growth of the Master's program in Computer Science. The main goal is to assess parallelization requirements for the Rocket Engine Numeric Simulator (RENS) project which, aside from gather information on liquid-propelled rocket engines and setting forth requirements, involve large FORTRAN based package at NASA Lewis Research Center. During the first year, the focus was on the Two-Dimensional Kinetics (TDK) software which had been developed and documented, mostly on VAX/VMS platforms using FORTRAN, during the period from 1986 to 1996. The activities involved porting and reconfiguration on HU's Sun network and Cray machines. This package which consists of over 280 modules lacked clear, concise, and consistent documentation because of the piecemeal nature of its development and revisions over a long period under rapidly changing technological base. Although the portings were successful, various benchmark results were shown in the final report, and several modules were translated into C language with the ultimate aim of translation to C++, the package was too big and unwieldy for one graduate assistant and the principal investigator. For the second year, it was decided that the focus be on PUMPDES and TURBDES packages for designing rocket engine pumps and turbines. These packages have less than 10 modules each and far superior documentation. They have already been successfully ported and installed on Hampton University's Sun local network using f77 and a Cray YMP machine using cf77 under a software agreement between NASA and Hampton University. As a result of the discussions involving new directions during RENS meeting in Pensacola, Florida (January 16-17, 1997), the current thrust is close cooperation with similar projects in the NPSS organization of LeRC for parallel execution of various FORTRAN based engine design tools over local networks, NASA's intra-nets and, ultimately, the internet. Toward this end, the PI will be given access to the LACE clusters for experimenting with these ideas involving remote access and executions. We are also exploring the possibility of C++ wrappers around the existing FORTRAN based code, such as TURBDES/PUMPDES. The advantages are software reuse, object-oriented re-design, and the Java option for browsing and execution over the internet.

WHY COSTING IS IMPORTANT ON HBCU GRANTS

over 70
end

WHY IS COST IMPORTANT?

COST

IS OUR ONLY FISCAL MEASURE OF ACTUAL WORK ACCOMPLISHMENT. IT CAN BE UTILIZED BY MANAGEMENT TO EVALUATE THE EFFICIENCY & EFFECTIVENESS OF BUDGET EXECUTION ON OUR PROGRAMS.

WHAT DOES FORWARD FUNDING MEAN?

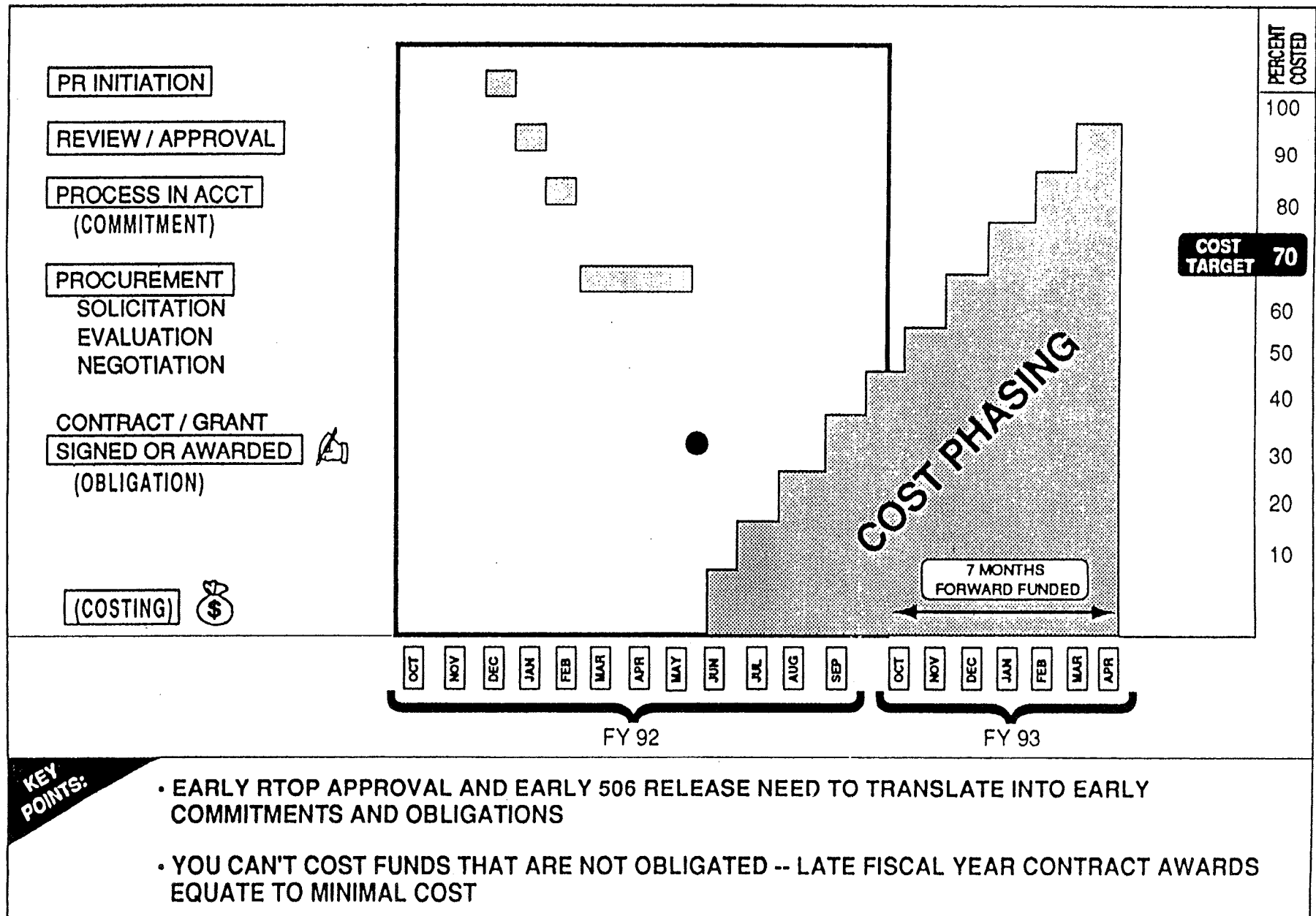
FORWARD FUNDING

IS EXPRESSED AS EITHER

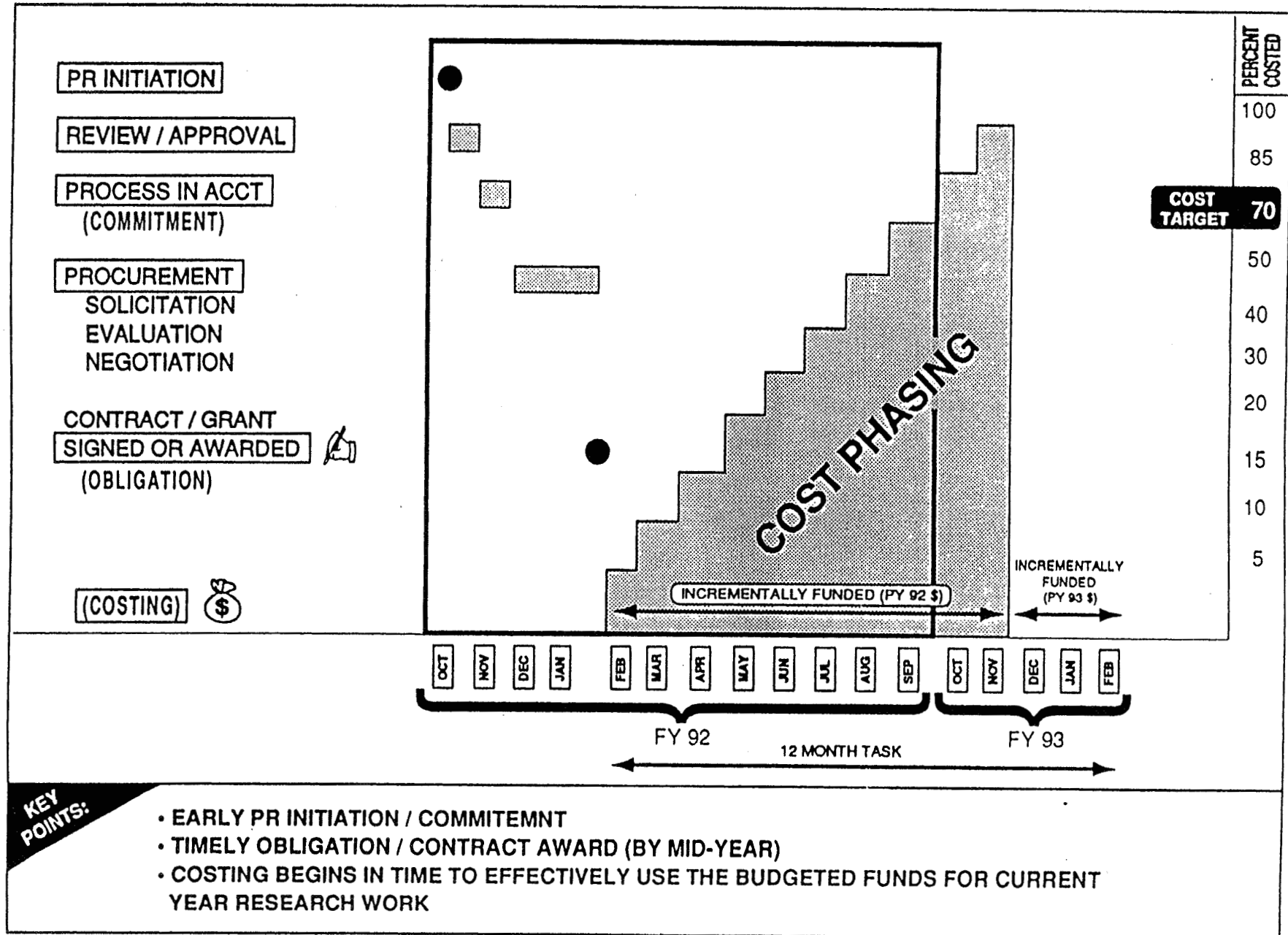
① THE AMOUNT OF FUNDING THAT ONE'S PROGRAM OR CONTRACT WILL NOT "COST" DURING THE CURRENT FISCAL YEAR. OR

② THE PERIOD OF TIME THAT YOUR CONTRACT IS FORWARD FUNDED INTO THE NEXT FISCAL YEAR.
(NOTE: RB's GUIDELINE IS THAT FORWARD FUNDING BE LIMITED TO NO MORE THAN 2 MONTHS ON ALL OAST CONTRACTS)

EXAMPLE OF POOR COST MANAGEMENT



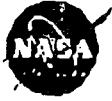
EXAMPLE OF GOOD COST MANAGEMENT



COST MANAGEMENT

⚙ CHECKING ACCOUNT ANALOGY ⚙

- CODE R POLICY ALLOWS 2 MONTHS OF FORWARD FUNDING ON CONTRACTS (BEYOND 9/30) AND A CARRYOVER OF 30% OF YOUR BUDGET ALLOCATION TO COVER EXPENDITURES IN THE FOLLOWING FISCAL YEAR
- HOW MANY MONTHS OF FORWARD FUNDING DO YOU MAINTAIN IN YOUR PERSONAL CHECKING ACCOUNT?
- FLIGHT CENTERS AND MAJOR AGENCY PROGRAMS OPERATE WITH LESS THAN 2 WEEKS OF FORWARD FUNDING INTO THE FOLLOWING FISCAL YEAR
- EXTERNAL AUDIT ORGANIZATIONS CAN'T UNDERSTAND WHY WE ASK FOR FUNDS IN OUR BUDGET REQUEST THAT WE WON'T SPEND IN THE CURRENT FISCAL YEAR.



Cost Management

- **NASA MUREP**
 - At least 80% of funds should be costed by the end of Federal fiscal year (September 30)
- **NASA MUREP Grantees**
 - Incremental funding of large \$ value grants or cooperative agreements
 - Minimize forward funding beyond 2 months into the following fiscal year
 - 100% of funds should be encumbered by the end of the grant year; funds not encumbered will be deducted from the first incremental funding, actual carryover will be deducted from the second incremental funding

How Can I Improve My Program's Cost Performance

RB Recommendations

- ① Timelier initiation of procurements
 - "Long leadtime" acquisitions (1st Qtr)
 - Planning PR's / initiations use while awaiting 506 (1st Qtr)
 - Small purchases / off-the-shelf buys (2nd Qtr)
 - Tasks on Support Service Contracts (1st Half of Year)
- ② Expanded use of "Incremental Funding" of Contracts
 - Recommended 2 actions per year (1-1st Qtr; 2-Midyear)
 - Avoid multiyear / 100% funding up-front scenarios
 - Use incremental funding on major fixed-price contracts also
- ③ Limit forward funding on incrementally-funded contracts (or major tasks on Support Service Contracts) to only one month
- ④ Implement a one-time adjustment to start dates on major grants / contracts that are not incrementally funded (startup in 1st Qtr, NOT 4th Qtr)
- ⑤ Ensuring that all legitimate accrued cost on your program is recorded in your Center fiscal systems in a timely and accurate manner
- ⑥ Base Budget Requests upon how much \$ your program will be able to cost over the 12/1/97 - 12/1/98 time frame

RECOMMENDATION

- **SUBMIT ALL NECESSARY INFORMATION BILLING TO YOUR COLLEGE FINANCE, ACCOUNTING, OR BILLING OFFICES ON A TIMELY BASIS (AT LEAST ONCE PER MONTH).**
- **INSURE THAT YOUR COLLEGE BILLING OFFICE SUBMITS REQUIRED BILLING INFORMATION TO NASA LEWIS EACH MONTH SO THAT LEWIS MAY PROPERLY REFLECT ACCURATE UP-TO-DATE COSTING ON YOUR HBCU GRANT.**

Donald J. Campbell

Donald J. Campbell is Director of the National Aeronautics and Space Administration's Lewis Research Center in Cleveland, Ohio. He was appointed to this position by NASA Administrator Daniel Goldin on January 6, 1994.

As Director, Mr. Campbell is responsible for planning, organizing, and directing the activities required to accomplish the missions assigned to the Center. Lewis is engaged in research, technology, and systems development programs in aeronautical propulsion, space propulsion, space power, and space sciences/applications. Campbell is responsible for the day-to-day management of these programs, which involve an annual budget of approximately \$1 billion, just under 2800 civil service employees and 2000 support service contractors, and more than 500 specialized research facilities located near Cleveland Hopkins International Airport and at Plum Brook Station in Sandusky, Ohio.

Campbell earned a bachelor's degree in mechanical engineering from Ohio Northern University, a master's degree in mechanical engineering and did predoctoral work at Ohio State University. He completed the Senior Executive Seminar in Management at Carnegie Mellon School of Urban and Public Affairs and the Federal Executive Institute Executive Leadership program. He also completed several senior management courses at Brookings Institute.

Campbell began his government career in 1960 as a test engineer for gas turbine engines and engine components in the Air Force Aero Propulsion Laboratory, Wright-Patterson Air Force Base, Ohio. He then worked as a project engineer and later as a program manager for advanced airbreathing propulsion systems.

From February to July 1986, Campbell was assigned as an interim Directorate Chief during the implementation of the National Aerospace Plane (NASP) Program Office, Wright-Patterson Air Force Base. He was Acting Director of the NASP Technology Maturation Directorate. In 1987, he became Acting Deputy Director of the Aero Propulsion Laboratory. In 1988, he was selected for the rank of Senior Executive Service and was appointed Deputy Program Director for the Propulsion System Program Office, Aeronautical Systems Division. He was the senior civilian executive for development and acquisition of new and derivative gas turbine engines for operational aircraft. In 1990, he was appointed Director of the Aero Propulsion and Power Laboratory. He was responsible for the Air Force propulsion and power research and development in the areas of gas turbine engines, ramjet engines, aerospace power systems, and fuels and lubricants.

In 1992, he was named Director of Science and Technology, Office of the Assistant Secretary of the Air Force for Acquisition, Washington, D.C. In this capacity he monitored the Air Force Science and Technology program and other selected research, development, technology, and engineering programs.

Campbell and his wife, Helen, have four children.

Dr. Michael J. Salkind
President, Ohio Aerospace Institute

Michael Salkind was appointed President of the Ohio Aerospace Institute in January 1990. OAI is a consortium of nine Ohio universities, private industry, NASA Lewis Research Center in Cleveland, and Wright-Patterson Air Force Base in Dayton. Its mission is to facilitate collaboration among industry, universities, and federal laboratories to enhance Ohio and U.S. economic competitiveness through research, education, and technology adaptation.

Before his appointment, Dr. Salkind served as Director of Aerospace Sciences, Air Force Office of Scientific Research, in Washington D.C. for 10 years. He was Chief of Structures at NASA Headquarters in Washington, D.C. from 1976 to 1980. From 1964 to 1975, he was with United Technologies Corporation as Chief of Advanced Metallurgy in their corporate research lab and then Chief of Structures and Materials at the Sikorsky Aircraft Division. He received his bachelor's and doctoral degrees in Materials Engineering from Rensselaer Polytechnic Institute in Troy, New York.

A fellow of the American Association for the Advancement of Science and an evaluator for the Accreditation Board for Engineering and Technology, he has published more than 40 articles and a book entitled Applications of Composite Materials.

He has also served on the adjunct faculty of The Johns Hopkins University, University of Maryland, and Trinity College in Hartford, Connecticut.

Dr. Julian M. Earls

Dr. Julian M. Earls, Deputy Director for Operations, NASA Lewis Research Center is a native of Portsmouth, Virginia. He earned the Bachelor's Degree, with distinction, in Physics from Norfolk State University; the Master's Degree in Radiation Physics from the University of Rochester School of Medicine; and the Doctorate Degree in Radiation Physics from the University of Michigan. Also, he earned the equivalent of a second Master's Degree in Environmental Health from the University of Michigan and is a graduate of the Harvard Business School's prestigious Program for Management Development. He has received the NASA Medal for Exceptional Achievement on two separate occasions.

He has 21 publications, both technical and educational. He has been Distinguished Honors Visiting Professor at numerous universities throughout the Nation and is an adjunct faculty member at Capital University, Columbus, Ohio. He was an adjunct faculty member at Cuyahoga Community College in Cleveland, Ohio. He has served on the Visiting Committee and the Board of Overseers at Case Western Reserve University, the Board of Trustees at Cuyahoga Community College, and recently was appointed by the Governor of Ohio to serve on the newly reconstructed Board of Trustees for Central State University.

Dr. Earls has received numerous honors for his community services. He has been designated the Black College Graduate of Distinction by the National Urban League and has been honored by Norfolk State University and the National Association for Equal Opportunity in Higher Education. He was inducted into the inaugural class of the National Black College Alumni Hall of Fame with such distinguished individuals as Dr. Martin Luther King, Jr. and Justice Thurgood Marshall. Recently he was honored by being among the nine individuals included in the Strong Men and Women; Excellence in Leadership Series by Virginia Power and North Carolina Power Companies. Others who have been included in the Series were: Dr. Johnnetta Cole, President of Spelman College; Henry Aaron, member Baseball Hall of Fame; Dr. John Hope Franklin, noted historian; retired General Colin Powell; Michael Jordan, Chicago Bulls basketball star; and noted poet, Maya Angelou. Dr. Earls is co-founder of the Development Fund for Black Students in Science and Technology which awards scholarships to black students who major in technical disciplines at Historically Black Colleges and Universities.

Dr. Earls is an avid runner and has run over 10,000 miles in the past five years. He has entered and successfully completed 15 marathons, including the Boston Marathon. He is married to the former Zenobia Gregory of Norfolk, Virginia, a Reading Curriculum Specialist in the Cleveland School System. They have two sons. Julian, Jr., a neurologist, is a graduate of Howard University and Case Western Reserve University School of Medicine. Gregory, a cinematographer, is a graduate of Norfolk State University and the American Film Institute in Hollywood, California.

Dr. Sunil Dutta

Dr. Sunil Dutta is Program Manager for Small Disadvantaged Businesses (SDBs) at the National Aeronautics and Space Administration's Lewis Research Center, Cleveland, Ohio. Appointed to this position in 1992, he is responsible for implementing policies that ensure the Small Disadvantaged Businesses (SDBs) and Historically Black Colleges and Universities (HBCUs) are encouraged and afforded an equitable opportunity to compete for NASA contracts and research grants. The goal is to increase R&D contracts with SDBs and research grants with HBCUs at Lewis Research Center. Before assuming the present position, his career has been devoted to research and development of materials science and technology, particularly in the area of processing, characterization, and mechanical behavior of high performance ceramics and ceramics matrix composites, for heat engines and high speed civil transport applications. In addition, he monitored numerous R&D contracts and grants for more than 10 years as project/program manager.

Dr. Dutta joined NASA Lewis Research Center in 1976 after 8 years at the U.S. Army Technology Laboratory, Watertown, Massachusetts. Born in India, he received his B.Sc (Hons), and M.S. from Calcutta University, and M.S. and Ph.D. from the University of Sheffield, England. He also received an MBA degree from Babson College, Wellesley, Massachusetts.

Dr. Dutta has written more than 50 publications including 4 patents and 5 chapters in books.

He is a Fellow of the American Ceramic Society, and the Institute of Ceramics in England. He is listed in American Men and Women in Science, Who's Who in Engineering, and Who's Who in the United States.

Dr. Dutta was invited to Japan for one year as Nippon Steel Endowed Chair Visiting Full Professor, at the University of Tokyo's Research Center for Advanced Science & Technology. Since 1987, he visited Germany, Japan, Korea, Singapore, Australia, and India to present invited technical papers/lectures. Also, actively consulted for industry and government including the CSIR (Council of Scientific and Industrial Research) laboratories in India, under the United Nations Development Program (UNDP).

He has actively participated in Local School PTA programs, as Vice-president of Canterbury Homeowners Association, as President of India Association in Boston, Massachusetts, and in Cleveland, Ohio; and co-convenor of 5th biennial National Convention of All Asian-Indians in North America.

Dr. Dutta and his wife Kabita reside in Westlake, Ohio. They have three children.

HBCUs RESEARCH CONFERENCE List of Attendees April 9-10, 1997

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